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US Army Engineering and Support Center, Huntsville



I DRANK THE KOOLAID... NOW WHAT? MIS AFTER TWO YEARS

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INTRODUCTION

- Multi-Increment Sampling 101
- Decision/Sampling Units
- Risk Assessment Issues
- Laboratory Issues
- Regulatory “Interferences”
- Summary



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MULTI-INCREMENT SAMPLING 101



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APPENDIX A to SW846 METHOD 8330B





WHAT IS MIS?

- Pooling of several individual increments from within the decision unit (can you say “composite”????)
- Intended to provide a more reliable estimate of the AVERAGE concentration
- Collection of field replicate samples (typically three) to provide an estimate of total uncertainty (RSD, RPD, 95% UCL)



SAMPLING ERRORS

- **Compositional heterogeneity**: not all particles within a population have the same concentration of target analytes
 - Maximum when analyte is present as a few discrete particles of pure material
- **Distributional heterogeneity**: contaminant particles scattered across the site unevenly
 - Maximum when a single discrete sample is used to estimate the mean for a large area



MIS CONSIDERATIONS

- What should the sample mass be to overcome compositional heterogeneity?
 - 1 kg or more
- How many increments are necessary to overcome distributional heterogeneity within the decision unit?
 - 30 grabs or more
- How large of an area can be adequately characterized with a multi-increment sample?
 - Decision unit is typically 25 to 10,000 m² (~2.5 acres)



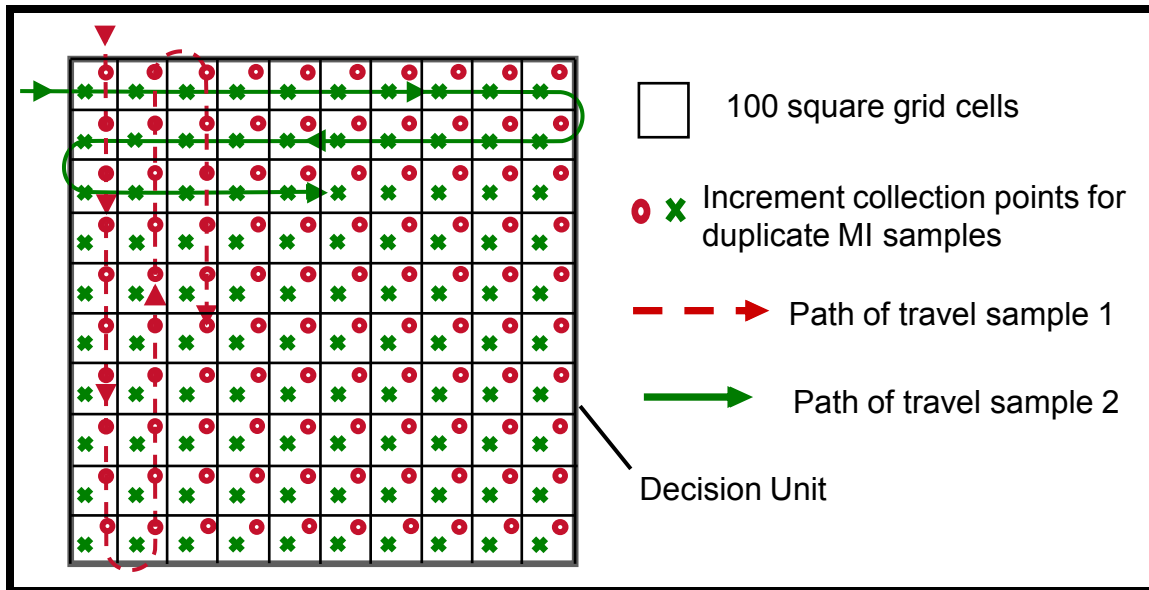
MIS CONSIDERATIONS

- How is decision unit established?
- What should the sampling depth be?
- Field work requires anomaly avoidance
- What are appropriate “action levels” based on multi-incremental samples?
- Required by Army MMRP RI/FS guidance (draft)



MIS CONSIDERATIONS

- How should increments be collected?
 - Systematic-random sampling design
 - Collection of replicate samples



Systematic Random Sampling for collection of duplicate 100-increment MI samples (Figure after CRREL, 2007). Nomenclature per Pitard, (1993, Figure 21.8); CRREL; and EnviroStat, Inc. There are nomenclatural differences in increment collection schemes between those and EPA, 1995 (540/R-95/141) and EPA 1989 (EPA/230/02-89/042).

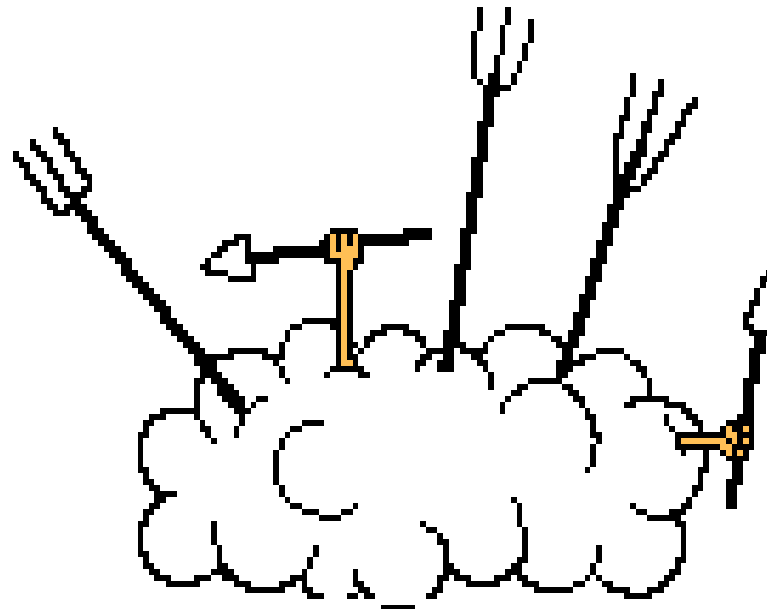


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DECISION UNITS and SAMPLING UNITS





DECISION UNITS

- Per the theory of MIS, **ALL** areas within a DU must have an equal chance of being sampled...the DU **should not contain** areas that have no chance of being sampled.
- New definition: “SAMPLING UNIT”



SAMPLING/DECISION UNITS

- The specific volume of soil (i.e. the population) for which MIS is used to obtain a representative estimate of the mean concentration of a constituent of concern (USACE, 2008)
- An area where a decision is to be made regarding the extent and magnitude of contaminants with respect to the environmental concerns posed by the contaminants (HDOH, 2008)



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DALHART PBR, TX

FUDS MMRP SI



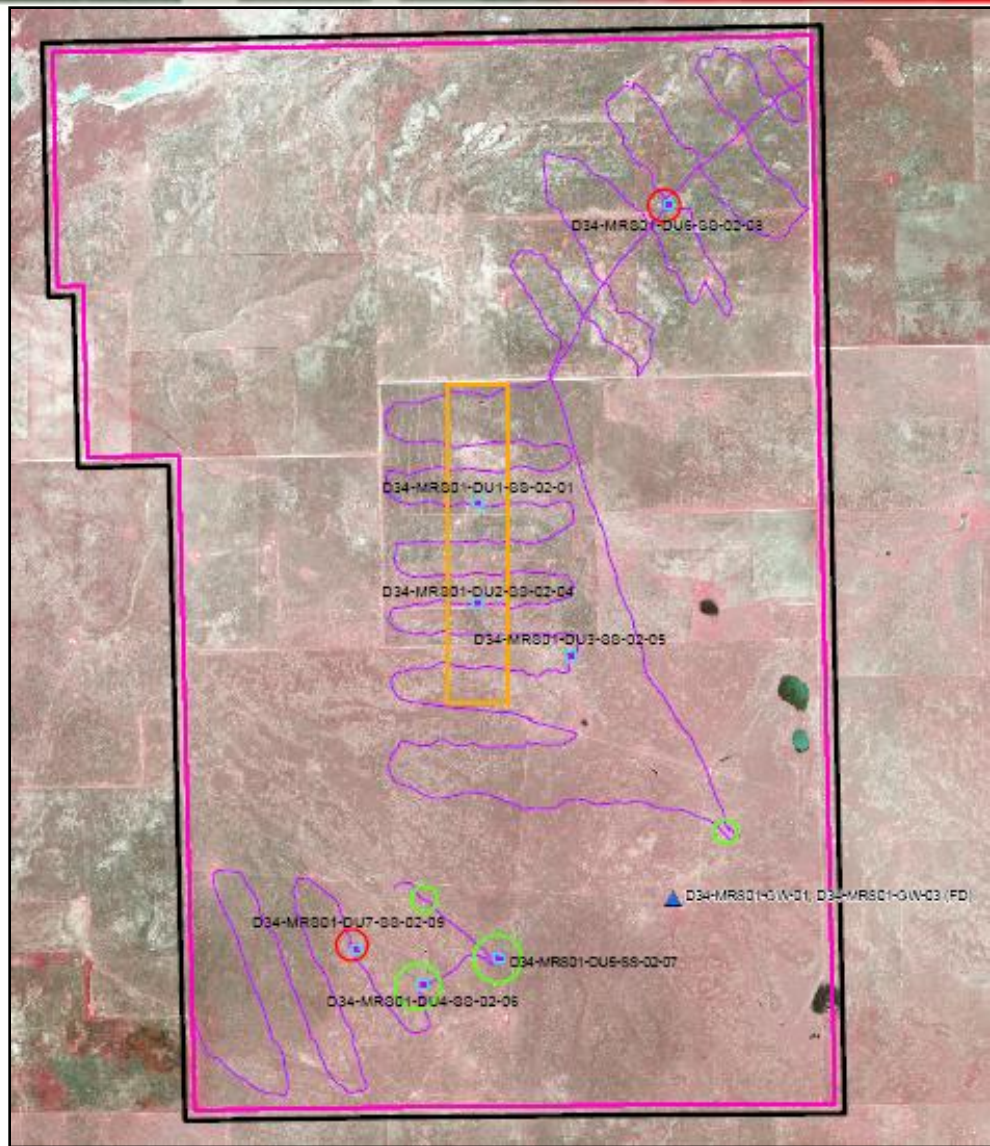
- Soil samples were collected from eight DU locations at Dalhart PBRs 3 and 4. Seven of these DU locations were selected to represent areas with the ***highest likelihood for the presence of MEC or MC contamination***, and one DU location was selected for an ambient soil sample.



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DALHART PBR, TX



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RISK ASSESSMENT ISSUES





RISK ASSESSMENT ISSUES

- Vegetation included (normally removed)
 - Analytical interferences?
- Samples are taken at 0-2” (Method 8330B)
 - Normally 0-6” or 0-12” (surface soil)
 - Introduces high bias for the exposure point concentration (EPC)
- Developed for surface soil sampling
 - Applicable to subsurface soil sampling?



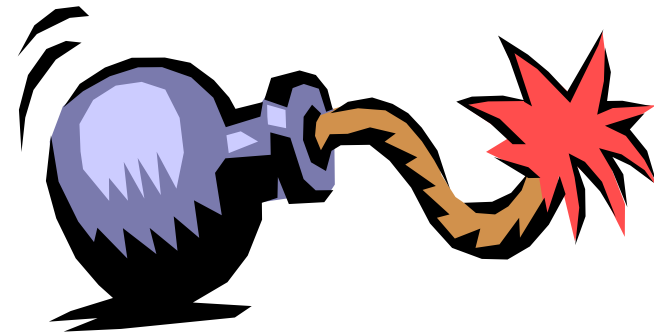
RISK ASSESSMENT ISSUES

- Particles >2 mm are removed
 - Safety considerations
 - Representative of actual exposures?
 - Available for analysis if required
- Grinding turns soil into talcum powder
 - Representative of actual exposures?
 - Misrepresents actual bioavailability?





RISK ASSESSMENT ISSUES



- **Derived for energetics**
 - Applicable to other analytes (i.e., metals, SVOCs, VOCs)?
- **Grinding** – increases metals concentrations
 - Due to bowl and puck?
 - Due to additional exposed surface area?
 - Can be duplicated for background samples
- **Does 95% UCL** based on 3 replicates make sense? (ProUCL won't let you do it)



RISK ASSESSMENT ISSUES

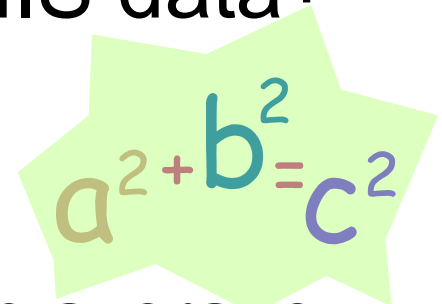
- What about hot spots?
 - Do we really care for chronic exposures?
 - Is exposure to acutely toxic concentrations possible?
 - All you get is the average concentration
 - No gradient of contamination...no spatial information





RISK ASSESSMENT ISSUES

- Can we combine discrete and MIS data?
 - MIS theory says “no”
 - Common sense says “no”
 - The average of an average and an average...
- Can we combine data from multiple SUs?
 - Statistics says “yes”...must be weighted
 - The average of an average and an average and an average...





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LABORATORY ISSUES





LABORATORY ISSUES

- Must have space to air dry MIS samples
- Must have grinding apparatus with adequate dust control to prevent cross-contamination
- Grinding generates heat (volatilization and thermal decomposition)
- Must have an SOP for the MIS sub-sampling



- **Laboratories that have demonstrated an acceptable MIS sub-sampling procedure:**
 - TestAmerica Denver of Arvada, CO
 - GPL Laboratories, LLC of Frederick, MD
 - APPL, Inc. of Clovis, CA
 - Analytical Laboratory Services, Inc. of Middletown, PA
 - TestAmerica Honolulu of Aiea, HI

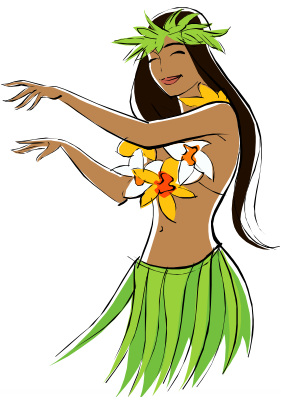


- **Laboratories requested (by USACE Districts) to have their sub-sampling procedure evaluated:**
 - Accutest Southeast of Orlando, FL (review almost complete)
 - TestAmerica West Sacramento of Sacramento, CA
 - TestAmerica Burlington of South Burlington, VT
 - Microbac Laboratories, Inc. of Marietta, OH



LABORATORY EXAMPLE

- **Lead analysis**, Expanded SI, SAFR, Hawai'i. (*samples were not ground*)
 - QC samples. **RPDs** for the field samples and QC samples are **27%** for decision unit 3 and **28%** for decision unit 5 (less than the **30%** established for the project).
 - Field, dup and trip. **RSD** is **72%**, which indicates that the results for the three samples vary from the average result and that **sampling method may have caused sampling errors.**





LABORATORY SPLITS

- Results for the primary sample and the QC sample, **336 mg/kg** and **298 mg/kg** respectively.
- Laboratory split samples were prepared by two methods with 15 samples collected using each method.
 - Rotary Splitter
 - Spatula
- Rotary splitter: **280 mg/kg** to **2,820 mg/kg**.
- Spatula: **279 mg/kg** to **2,950 mg/kg**.
- Oooops!!!!!! We're working on it...



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REGULATORY “INTERFERENCE”



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“WE LOVE IT!!!!!!”

Hawai'i Dept. of Health (guidance)

Alaska Dept. of Environmental Quality (guidance)

USEPA Region 6

Texas Commission on Environmental Quality

New Mexico Environment Department



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“YOU WANNA DO WHAT?”

USEPA Region 3

USEPA risk assessors (generally)

Georgia Environmental Protection Dept.

Florida Dept. of Environmental Protection

Arkansas Dept. of Environmental Quality



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Now...be quiet and drink more koolaid...

QUESTIONS?

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